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Indian Standard
CODE OF SAFETY FOR PHOSGENE

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Indian Standard

CODE OF SAFETY FOR PHOSGENE

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 31 August 1976, after the draft finalized by the Chemical Hazards Sectional Committee had been approved by the Chemical Division Council.

0.2 Phosgene is also known as carbonyl chloride, carbon oxychloride, chloroformyl chloride, combat gas and D-staff. It is represented by the formula $COCl_2$. It is a gas at ordinary temperature. Phosgene is an important chemical used in industries, such as pharmaceuticals, dyes, fine chemicals and in many organic synthesis reactions. Detailed knowledge about its toxicity and hazards is useful in ensuring safety in the use of this chemical. This standard is intended to help the users to recognize the hazard and take necessary safety measures.

0.3 The properties of phosgene given under **3** have been taken from literature and have been included for information only. Moreover, these properties pertain to pure phosgene.

0.4 In the preparation of this standard, assistance has been drawn from the following publications:

PATTY (Frant A). Industrial hygiene and toxilogy, Vol II.

Hygiene guides series. American Industrial Hygiene Association.

SAX (N I). Dangerous properties of industrial chemicals.

Method for the detection of toxic substances in air, Booklet No. 8. Her Majesty's Stationery Office, UK.

0.5 This edition 1.1 incorporates Amendment No. 1 (December 2006). Side bar indicates modification of the text as the result of incorporation of the amendment.

1. SCOPE

1.1 This code describes important physical, chemical and toxic properties of phosgene and the associated hazards and important useful information on storage, handling, packing and labelling, selection and training of personnel, personal protection, medical information and first aid.

1.1.1 This code does not deal with specification for design of buildings, storage vessels, engineering plants and equipment for operational control.

1.2 Attention of the users of this code is directed to the fact that the production, storage, transport, import and export of phosgene in India is controlled by the Chief Controller of Explosives of the Government of India under the Inflammable Substances Act, 1952. The statutory regulations are embodied in the Petroleum Rules, 1937 issued by the Government of India.

2. TERMINOLOGY

2.1 For the purpose of this code, the definitions given in IS : 4155-1966* and IS : 4167-1966† shall apply.

3. IMPORTANT PROPERTIES

3.1 Some of the important properties of phosgene are as follows:

a)	Molecular mass	98.9
b)	Melting point	– 104°C
c)	Boiling point	+ 8.2°C
d)	Vapour density	3.4 (Air = 1)
e)	Solubility	Slightly soluble in water. Undergoes slow decomposition to carbon dioxide and hydrochloric acid. Highly soluble in benzene, toluene, glacial acetic acid and organic liquid hydrocarbons
f)	Odour	Odour similar to that of green corn or newly mown hay or musty small
g)	Principal route of entry	By inhalation
h)	Reactivity	When heated or decomposed by steam, toxic and corrosive products are generated
j)	Specific gravity	1.435

4. HAZARDS ASSOCIATED WITH PHOSGENE

4.1 General — Phosgene is extremely poisonous. It is likely to be encountered wherever chlorinated carbon compounds are decomposed due to exposure to heat or on contact with hot surfaces. Such decomposition is known to occur in the presence of ultraviolet radiation.

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*Glossary of terms relating to chemical and radiation hazards and hazardous chemicals.

†Glossary of terms relating to air pollution.

HQ (SALES)

Hence shielded are electric welding should not be undertaken in the vicinity of areas where chlorinated hydrocarbon vapours may be present. This chemical is also one of the by-products of decomposition of carbon tetrachloride used in extinguishing fires.

4.2 Threshold Limit Value (TLV*) in Air — The upper limit of phosgene vapour considered safe for continuous exposure for 8 hours work day and 40 hours work week is 0.1 ppm (0.4 mg/m^3). This value may be used as guideline in controlling environmental contamination and personnel exposure.

4.3 Routes of Entry — The principal route of entry for the gas is through inhalation. Phosgene is not readily absorbed through skin under normal conditions.

4.4 Chronic Toxicity — Phosgene is not known to give rise to cumulative effects.

4.5 Acute Toxicity (Local)

4.5.1 *Skin* — Gaseous phosgene may cause irritation of skin. If liquid phosgene is splashed on the body, burns may be caused.

4.5.2 *Eyes* — Low concentration of gas can cause severe irritation of eyes.

4.6 Acute Toxicity (Systemic) — Phosgene is primarily a respiratory irritant. It affects the upper respiratory tract as well as the lungs. The effects of exposure to phosgene are not immediate but may be delayed by a few hours. The delayed symptoms which cause sudden development of severe pulmonary edema is attributed to the hydrolysis of phosgene in the moist terminal air spaces in the lungs. The liberated acid causes severe irritation of lung tissues leading to edema. Death may then result from suffocation or heart failure. The insidious and delayed effects of phosgene are similar to those of oxides of nitrogen.

4.6.1 Exposure to very high concentration of phosgene may cause immediate corrosive effects on the lung tissues. The immediate signs and symptoms of exposure are dry or burning sensation in throat, choking, feeling of constriction, numbness, coughing, bronchitis, painful breathing, pain in the chest, dyspnoea, bloody sputum, etc.

4.6.2 A whiff of phosgene may cause burning sensation in pharynx, larynx and nose.

4.6.3 Prolonged exposure to very low concentrations is said to cause olfactory fatigue affecting the sense of smell.

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*As accepted by the American Conference of Governmental Industrial Hygienists, USA.

4.6.4 The physiological response to varying concentrations of phosgene is given below:

Physiological Response	*Concentration of Phosgene*	
	in ppm*	in mg/m^3
Threshold limit value	0.1	0.4
Easily recognized by trained personnel	0.5	2.0
Strong odour	2.0	8.0
Dangerous to life from prolonged exposure	1.25 to 2.5	5 to 10
Coughing within 1 min	5	20
Irritation of eyes and respiratory tract within 1 min	10	40
Dangerous to life within 30-60 min	12.5	50
Severe lung injury within 1-2 min	20	80
Dangerous to life within 30 min	25	100
Rapidly fatal 30 min or less	90	360

5. PACKING AND LABELLING

5.1 Phosgene is usually supplied in cylinders as a liquefied gas.

5.2 The following label is suggested as an addition to or in combination with other warning labels. It should have on its upper half the symbol as prescribed in IS : 1260 (Part I)-1973†.

> *Phosgene* — Poisonous gas. Irritating and highly toxic gas. If exposed, consult a doctor. Symptoms of exposure are delayed by several hours. Store in well ventilated and cool area away from corrosive chemicals. Always use proper eye and respiratory protection.

6. PREVENTIVE MEASURES

6.1 General — Phosgene should be used only with adequate ventilation. Severe exposure may occur due to inadequate ventilation, use in confined space or very high concentration of the gas. Phosgene may react violently with water, ammonia, primary amines, active metals, alkalis, and other materials.

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*Part per million parts of air by volume.

†Pictorial marking for handling and labelling of goods: Part I Dangerous goods (*first revision*).

6.2 Ventilation — The ventilation system shall be able to keep the concentration of phosgene below TLV of 0.1 ppm. The exhaust shall be treated with ammonium hydroxide to neutralize phosgene to avoid atmospheric pollution. (There will be white dense fumes if phosgene is present.)

6.2.1 The working area shall be frequently tested by means of either ammonia dipped rod or suitable indicator paper (made from diphenylamine and *p*-diphenylamine benzaldehyde).

6.3 Eye Fountains — Since phosgene is also an irritant for the conjunctiva, it is advisable to provide suitable eye fountains in the respective areas.

6.4 Storage — Phosgene containers shall be stored in a cool, dry area with effective ventilation provision. Phosgene shall be kept away from source of heat, combustible and corrosive materials. The ventilation system shall be provided with a fixed provision for ammonia cylinder connections to meet any emergency as well as to avoid atmospheric pollution.

6.4.1 Persons entering the stores shall first confirm that the ventilation is on. Put on the gas mask and enter.

6.4.2 Test the atmosphere for presence of phosgene with a gas detector or with ammonia dipped rod or with suitable indicator paper.

6.4.3 Detect the leaky cylinder and isolate from other cylinders. Try to close the leaky valve. In case of failure, the cylinder shall be brought near the neutralizing pit, fix an improvised cylinder valve cap with a nipple and connect the nipple with a flexible hose, the other end shall dip into dilute alkali solution.

7. EMPLOYEE EDUCATION AND TRAINING

7.1 Employees likely to work with phosgene shall be thoroughly instructed and trained about: (a) nature of the hazards associated with the chemical; (b) the usual possible signs and symptoms of exposure; (c) the insidious nature of its effects; (d) the correct use of proper personal protective equipment, adequate ventilation, etc; and (e) the actions to be taken in an emergency.

8. PERSONAL PROTECTIVE EQUIPMENT

8.1 Personal protective equipment is not a substitute for safe working conditions. It should, however, be available at all times in a ready-to-use condition. It should be kept in a readily accessible position. The equipment should be frequently inspected, checked, disinfected and maintained properly. It should be remembered that personal protection equipment protects only the person wearing it.

8.2 Employees working with phosgene should use gas tight chemical goggles, respiratory protection consisting of a mask with canister for organic vapours and acid gases where the gas concentration is low, and self-contained breathing apparatus in high or unknown gas concentration.

8.3 Other personal protective equipment such of aprons, gloves, footwear and head wear should be used according to the job requirements. Leather is not recommended.

9. MEDICAL EXAMINATION

9.1 Employees likely to work with phosgene should undergo pre-employment placement examination. Persons with chronic pulmonary diseases and disorders should not be employed in jobs which involve exposure to phosgene.

9.2 Periodical examination of the employees should involve detailed physical examination, X-ray and when possible pulmonary function tests.

10. EMERGENCY AND FIRST AID

10.1 If liquid phosgene has splashed on skin or in eyes, a thorough washing immediately with water for 15 min or more, is essential. A physician should be consulted immediately.

10.2 If phosgene has been inhaled in unknown concentration, complete bed rest is essential. The victim should be kept under medical supervision for at least 24 hours in view of the insidious character of toxic symptoms.

10.3 If the exposure has occurred to very low concentration, immediate removal to fresh air is recommended.

10.4 It may be necessary to administer oxygen if signs of pulmonary edema are seen. This should be done by a physician or a specially trained technician. The pressure of the gas has to be carefully watched and controlled.

10.5 Since obvious symptoms do not appear after exposure, anyone inhaling the gas should be covered to prevent heat loss. Even minor physical effort especially walking and unnecessary talking are to be avoided. Contaminated clothing should be removed. It is useful to administer oxygen from the start in the absence of symptoms. A physician should be consulted as soon as possible or the person shifted to a hospital.

(*Continued from page* 2)

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INDIAN STANDARDS ON CHEMICAL AND ALLIED HAZARDS

IS:

1260 (Part I)-1973	Pictorial markings for handling and labelling of goods: Part I Dangerous goods
1446-1959	Classification of dangerous goods
4155-1966	Glossary of terms relating to chemical and radiation hazards
4209-1966	Code of safety for chemical laboratories
4262-1967	Code of safety for sulphuric acid
4263-1967	Code of Safety for chlorine
4264-1967	Code of safety for caustic soda
4312-1967	Code of safety for lead and its compounds
4544-1968	Code of safety for ammonia
4560-1968	Code of safety for nitric acid
4607-1968	Classification of hazardous chemicals and chemical products
4644-1968	Code of safety for benzene, toluene and xylene
4906-1968	Code of safety for radiochemical laboratory
5184-1969	Code of safety for hydrofluoric acid
5208-1969	Code of safety for acetic acid
5302-1969	Code of safety acetic anhydride
5311-1969	Code of safety for carbon tetrachloride
5685-1970	Code of safety for carbon disulphite (carbon bisulphide)
6156-1971	Code of safety for chlorosulphonic acid
6164-1971	Code of safety for hydrochloric acid
6269-1971	Code of safety for ethylene oxide
6270-1971	Code of safety for phenol
6818-1973	Code of safety for phosphoric acid
6819-1973	Code of safety for calcium carbide
6953-1973	Code of safety for bromine
6954-1973	Code of safety for caustic potash
7415-1974	Code of safety for aniline
7420-1974	Code of safety for phthalic anhydride
7444-1974	Code of safety for methanol
7445-1974	Code of safety for acetone
7812-1975	Code of safety for mercury
8185-1976	Code of safety for phosgene

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